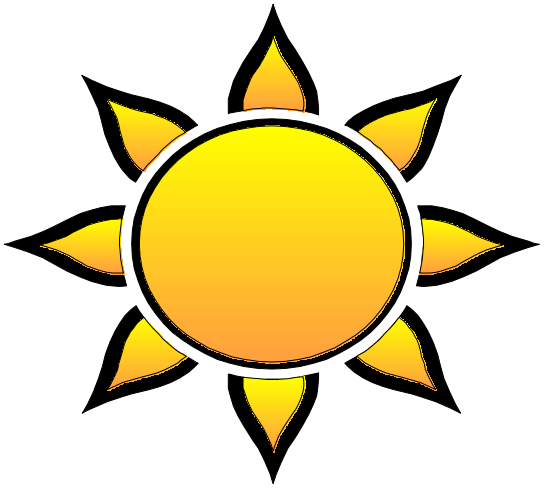
GETTING ENERGIZED!

Teacher's Activity Guide for Elementary Grades 3-6



National Renewable Energy Laboratory
Education Programs Office
1617 Cole Blvd.
Golden CO 80401-3393
Tel: (303) 275-3044
Fax: (303) 275-3076
E-mail: linda_lung@nrel.gov
URL: http://www.nrel.gov/business/education.html

ACKNOWLEDGMENTS

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Cheryl Beckwith, *4th grade, Eiber Elementary, Jefferson County Schools*
Mary Edwards, *3rd grade, Governor's Ranch Elementary, Jefferson County Schools*
Rick Hanophy, *6th grade, Smiley Middle School, Denver Public Schools*
Ruby Wendling, *4th grade, Westgate Elementary, Jefferson County Schools*

A special thank you also is extended to **Professor James Schreck**, Department of Chemistry and Biochemistry at the University of Northern Colorado for his assistance in the development of these kits.

It is the goal of the Education Programs Office to make these kits accessible, easy to use, and fun. We want your students to gain, not only an understanding of renewable and nonrenewable energy resources, but a greater confidence in investigating, questioning, and experimenting with scientific ideas. Your feedback on the evaluation form found at the end of this packet is very important for us to continue to build and improve this kit.

If you have questions, please call Linda Lung, Education Programs Office, (303) 275-3044 or e-mail: linda_lung@nrel.gov.

TO THE EDUCATOR

This activity kit was developed by the Education Programs Office at the National Renewable Energy Laboratory. Activity kits are available for grades K-6 in response to numerous teacher requests. *Users of these kits should practice appropriate safety guidelines in doing demonstrations or hands-on activities.*

STATE CONTENT STANDARDS

The activities in this kit address portions of the following guidelines from the Colorado Science Standards.

1.0 Students understand the processes of scientific investigation, and design, conduct, communicate about, and evaluate such investigations.

2.0 Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (Focus: Physics and Chemistry)

2.2 Students know that energy appears in different forms, and can move (be transferred) and change (be transformed).

2.3 Students understand that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.

3.2 Students know and understand interrelationships of matter and energy in living systems.

5.0 Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

ASSESSMENTS/RUBRICS

A separate section on Task Assessments provides examples of methods to evaluate a student's grasp of major concepts presented in the activities. Teachers are encouraged to use these assessments as-is or to develop their own that will meet the individual needs of students. The assessments in this kit usually involve open-ended, problem-solving activities but some will require recall of content knowledge.

Included with the assessments is a standard, generic rubric. The rubric is established as *a guideline for performance*. It also is a useful form of self-evaluation because they let the student know what is expected for high quality work. Harriet Yustein, a teacher from Suffern, New York, states that, "Through experience I have found that the best rubrics come from the children themselves. You should model what you want them to do and then they will discuss exactly what you want from them. That will be their rubric."

CONCEPTS

This activity kit is designed for elementary grades 3-6, and is appropriate for discussion of energy concepts at these grade levels. The concepts developed through the activities in this kit include:

- energy sources (renewable and nonrenewable)
- uses and limits of energy
- conversion of energy forms
- conservation of energy
- future energy resources

TEACHING-LEARNING MODEL

Each activity follows a format developed by the National Center for the Improvement of Science Education. The model is based on the "Immersion Approach" where teachers actually complete research projects in a laboratory setting. Once teachers have experienced "real life" laboratory research, they are more familiar with how they solve scientific problems. The Teaching-Learning Model is the result of these lab experiences. Rather than taking a cookbook approach to doing activities, teachers have found that students learn content and process through these steps:

TEACHING-LEARNING MODEL

INVITE
Big Question, Present Problem
Uses Meaningful Context, Motivates Student/Investigator, Real-Life Situation

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EXPLORE, DISCOVER, CREATE
Gather Information, Brainstorm Solutions
Introduce New Vocabulary and New Concepts, Practice Techniques, "Need to Know"

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PROPOSE EXPLANATIONS AND SOLUTIONS
Analyze Data, Apply New Knowledge
Share Information, Conclude

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TAKE ACTION
Present Findings, Ask New Questions
Generate Ideas for Further Investigation, Present Findings to Classroom

ACTIVITY OUTLINE

The activities in this kit address energy concepts as follows:

Elementary 3-6

Energy Sources	Activity 1 Learning About Energy Sources Activity 2 Energy Talk--Part I Activity 3 Energy Talk--Part II
Energy Uses/Limits	Activity 4 How Long Will It Last?--Part I Activity 5 How Long Will It Last?--Part II Activity 6 Now You're Cooking!
Energy Conversion	Activity 7 Leaf Relay Activity 8 Energy Conversions
Energy Conservation	Activity 9 Save or Waste? Activity 10 New Old Paper Activity 11 The Best Color
Energy for the Future	Activity 12 Rain Machine

Note: Materials are provided in kits for classrooms of 30 students. However, the following items will need to be provided by the teacher: SCISSORS, RULERS, CRAYONS, MARKERS, GLUE STICKS, BUTCHER PAPER, WATER, SINK (OR BUCKET).

RESOURCES

A Teacher's Background is included to help teachers with basic energy concepts, and to help them be more knowledgeable and comfortable in discussing these concepts with students. A Student Assessment is provided.

Materials found in this curriculum packet were adapted from several sources including:

- "Teach With Energy! FUNdamental Energy, Electricity and Science Lessons for Grades K-3," National Energy Foundation, Utah.
- "Energy Conservation Activities for the Classroom K-12," Kentucky Department of Education.
- "Science Activities in Energy," U.S. Department of Energy, Washington DC.
- "Award Winning Energy Education Activities for Elementary and High School Teachers," U.S. Department of Energy, Washington DC.
- "Iowa Developed Energy Activity Sampler K-12," Energy Division Iowa Department of Natural Resources.
- "Energy Activities for the Primary Classroom," California Energy Extension Service.

TEACHER BACKGROUND

The following information is provided as a resource to the teacher. More specific notes are provided at the beginning of some activities and the kit contains a packet of FACT SHEETS relating to renewable energy topics. There are, of course, many other resources. Please contact the Education Programs Office at the National Renewable Energy Laboratory, (303) 275-3044 for more information or the Energy Efficiency and Renewable Energy Clearinghouse (EREC) at 1-800-363-3732.

INTRODUCTION--WHAT IS ENERGY?

Energy gives us the ability to do things such as climb a mountain, play soccer, and even think. And there are many types of energy--some is stored in our muscles and brain cells, some is used to move around and play, while other types of energy are used to light a street lamp, heat or cool our homes, cook our food, and power buses, planes and cars.

Energy causes movement. Every time you see something move, energy is being used. A leaf moving in the wind, a pot of boiling water, and a school bus traveling to school are all evidence of energy being used. You know that energy exists because you can see or feel what it does. Energy moves cars, makes machines run, heats ovens, and lights our classrooms.

One form of energy can be changed into another form. When gasoline is burned in a school bus engine, the energy stored in gasoline is changed into heat energy. When we stand in the sun, light energy is changed into heat. When you turn on a flashlight, chemical energy stored in the battery is changed into light and heat.

To find energy, look for motion, heat, light, sound, chemical reactions, or electricity.

The sun is the source of all energy. The sun's energy is stored in coal, petroleum, natural gas, food, water, and wind.

While there are two types of energy, ***renewable and nonrenewable***, most of the energy we use comes from burning nonrenewable fuels--coal, petroleum or oil, or natural gas. These supply the majority of our energy needs because we have designed ways to transform their energy on a large scale to meet consumer needs. Regardless of the energy source, the energy contained in them is changed into a more useful form - electricity.

WHY DO WE MAKE ELECTRICITY?

We make electricity to provide energy for a lot of things. In fact, we often take electricity for granted because it is such an important part of our life style. It makes our everyday endeavors convenient and practical. For example, electricity makes alarm clocks ring in the morning to wake us for school, keeps food cool in the refrigerator so that cereal tastes good with milk, operates the blow dryer that styles hair, and runs the furnace that blows warm air throughout our homes in the winter to keep us warm while we get

ready for school.

HOW DO WE MAKE ELECTRICITY?

One of the fossil fuels (usually coal) is burned in a power plant to heat water. The hot water turns into steam and forces a machine called a turbine to turn. The turbine powers a generator into electricity which is sent through power lines to provide energy for buildings of all types.

In summary, *coal 6 hot water 6 steam 6 turbine 6 generator 6 electricity*.

Electricity can also be made from windmills or from water behind a dam. Falling water or rotating windmill blades will cause turbines to generate electricity.

WHY IS IT IMPORTANT NOT TO WASTE ENERGY?

In any energy conversion process, energy is *not* changed in *quality*. You can observe this by standing near an idling school bus engine. The engine gets very hot! Not all the chemical energy stored in the gasoline is converted into mechanical energy that moves the bus. Some energy is changed into heat energy that warms the air surrounding the engine. So, some of the energy stored in the gasoline is wasted. The *quality* of the original energy put into the process is not the same as the energy released.

The amount of fossil fuels is limited (no new reserves of these ancient fuels is being produced) and we will eventually run out of current supplies. It is important to conserve (save) these resources, while we experiment with the possibility of using renewable resources to meet our energy needs. Scientists at NREL are looking for ways to meet our energy needs using renewable energy sources. In the meantime, it is important that citizens not waste energy in any form. All of us need to be aware of things we can do to minimize the loss of energy. If the energy is lost, we don't have it available to use when we need it.

WHAT ELSE CAN WE USE FOR ENERGY?

Use of fossil fuels to make energy changes is complicated by the fact that they are the primary causes of environmental pollution including smog, acid rain, and the Greenhouse Effect. Smog is formed when exhaust fumes of cars and buses mix with sunlight. The resulting thick, brown haze can be seen over some cities on occasion in winter. It can irritate eyes and lungs. Acid rain is caused by the sulfur present in coal. When coal is burned to generate electricity, the sulfur is changed into a gas that will dissolve in water and fall to ground as rain or snow. The acid formed in acid rain is like that in lemon juice or vinegar. Acid rain can damage buildings and statues made of stone, trees, and food crops. The greenhouse effect arises when too much carbon dioxide from burning fossil fuels is produced. Increased amounts cause a warming of the atmosphere surrounding the earth much like that in a greenhouse. Too much warming could alter earth's weather and cause the polar caps to melt resulting in flooding of coastal cities.

Because our reserves of fossil fuels are dwindling, scientists are exploring other energy sources. Energy sources of the future must be more plentiful, and less harmful to the environment. Scientists are exploring these forms of energy to generate electricity:

- Solar energy - using the sun
- Wind energy - using wind to turn a windmill
- Nuclear energy - splitting uranium atoms to create heat energy
- Geothermal energy - harnessing heat and steam generated below Earth's surface
- Waves and Tides - using the force of ocean waves and tides
- Biomass - producing fuels from living materials or decayed waste materials

HOW MANY WAYS ARE THERE TO SAVE ENERGY?

Energy saved is energy gained for another day! Saving energy will cut down on pollution and help our fossil fuels last longer, at least, until the renewable energy resources become more practical and affordable. Here are some energy saving tips that students should know:

- Turn off the radio and television when not in use.
- Turn off the lights when you are not using them.
- Use a solar powered calculator instead of a battery powdered calculator.
- Ride the bus to the Rockies or Broncos game instead to taking the car.
- Don't leave the refrigerator door open for a long time.
- Don't use an electric toothbrush.
- Use a hand operated can opener, not an electric one.
- Use a sweater to stay warm in the winter instead of turning up the thermostat.
- Recycle your pop cans, glass bottles and plastic containers.
- Use a fluorescent bulb instead of an incandescent one.
- Pass the clothes you've outgrown to a brother or sister or to someone who needs them.